

# Introduction to AGWA

## The Automated Geospatial Watershed Assessment Tool

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### *Introduction to AGWA for BAER scenarios*

<b>Introduction:</b>	In this exercise you will assess the impact of a wildfire on runoff and erosion in a burned watershed
<b>Goal:</b>	To familiarize yourself with AGWA and its application for post-fire BAER scenarios
<b>Assignment:</b>	Run the KINEROS2 model on both a pre- and post-fire scenario on a watershed burned by the 2013 Mountain Fire in the San Jacinto Mountains of California, and view the results.

### Background

Mitigating the impacts that wildfire has on a watershed's response to precipitation is a primary objective of Burned Area Emergency Response (BAER) teams. Weather and climatic conditions often force these teams to make rapid post-fire assessments for decision-making on how and where to deploy remediation measures. Building and running distributed hydrological models to predict potential impacts of fire on runoff and erosion can be a time-consuming and tedious task. The USDA-ARS Southwest Watershed Research Center, in cooperation with the U.S. EPA Office of Research and Development, and the University of Arizona developed the AGWA geographic information system (GIS) based tool to facilitate this process. A GIS provides the framework within which spatially-distributed data are collected and used to prepare model input files and evaluate model results in a spatially explicit context.

### The Study Area

The Mountain Fire began on July 15, 2013 on private land in Riverside County, CA, and burned a total of 27,531 acres before being declared contained on July 30. Over 50% of the burned area was within the San Bernardino National Forest, while approximately 30% was within land under the jurisdiction of the Department of the Interior (DOI). The burned DOI lands included 2,443 acres of Bureau of Land Management lands, and 5,783 acres of Bureau of Indian Affairs, the Agua Caliente Band of Cahuilla Indians (ACBCI) lands. A national DOI BAER team was assigned to assess the DOI lands. This exercise will focus on the Andreas Canyon watershed of 5,628 acres, with an upper watershed in the San Bernardino National Forest, and a lower watershed in ACBCI lands.

From the BAER perspective, Andreas Canyon was of particular interest because about two-thirds of the watershed burned and several values at risk (VARs) were located within the watershed (Figure 1). These VARs included a road culvert at the outlet of the watershed, at a United States Geological Survey (USGS) stream gage located within the Andreas Day Use Area, and at the boundary between the National Forest and the ACBCI lands. The Day Use Area receives many visitors and has infrastructure at risk of flooding.

AGWA will be used to apply a burn severity map to the National Land Cover Data 2006 (NLCD 2006) to produce a modified land cover representing the burned condition of the watershed. The original pre-fire NLCD 2006 dataset and the modified post-fire NLCD 2006 dataset will be used to parameterize the KINematic Runoff and EROsion Model (KINEROS2; Goodrich et al. 2012; [www.tucson.ars.ag.gov/kineros](http://www.tucson.ars.ag.gov/kineros)). A discussion on the selection of parameter values used to parameterize the models for simulating post-fire runoff and sediment transport is presented by Canfield et al. (2005)<sup>1</sup> and Goodrich et al. (2005)<sup>1</sup>.

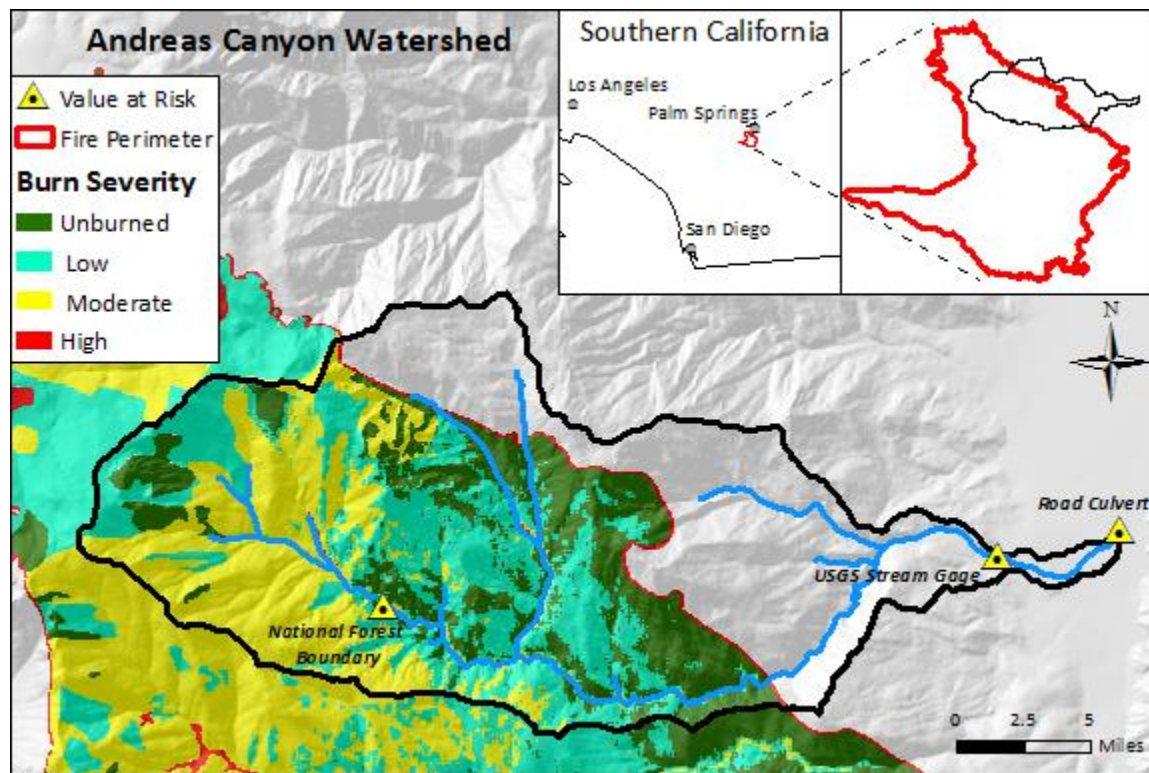


Figure 1. The Andreas Canyon watershed location, with Mountain Fire burn severity. The watershed is outlined in black.

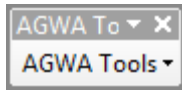
This exercise examines the effects of fire on the hydrology of the Andreas Canyon watershed. The results disclose immediate changes to the hydrologic regime that are attributable to fire. Changes include the impairment of water resources due to increases in sediment yield and increase of risk due to higher runoff peaks.

## Getting Started

Start ArcMap with a new empty map. Save the empty map document as **tutorial\_MountainFire** in the **C:\AGWA\workspace\tutorial\_MountainFire** folder (you may need to create the tutorial\_MountainFire folder). If the **AGWA Toolbar** is not visible, turn it on by selecting **Customize > Toolbars > AGWA Toolbar** on the ArcMap Main Menu bar. Once the map document is opened and saved, set the Home, Temp, and

<sup>1</sup> Available in PDF format on the AGWA website, <http://www.tucson.ars.ag.gov/agwa/>.

Default Workspace folders by selecting **AGWA Tools > Other Options > AGWA Preferences** on the **AGWA Toolbar**.



- Home: **C:\AGWA\**
- Temp: **C:\AGWA\temp\**
- Default Workspace: **C:\AGWA\workspace\tutorial\_MountainFire\**


The default workspace location may need to be created by clicking on **Make New Folder** button in the window that opens if you did not create it when saving the map document.

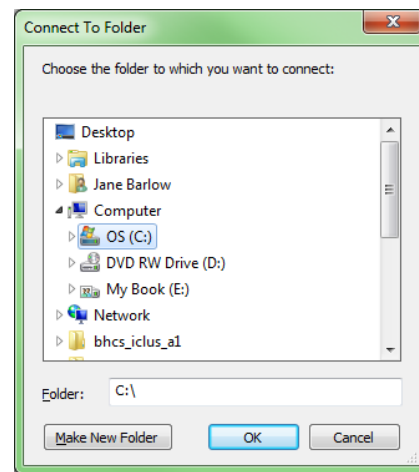
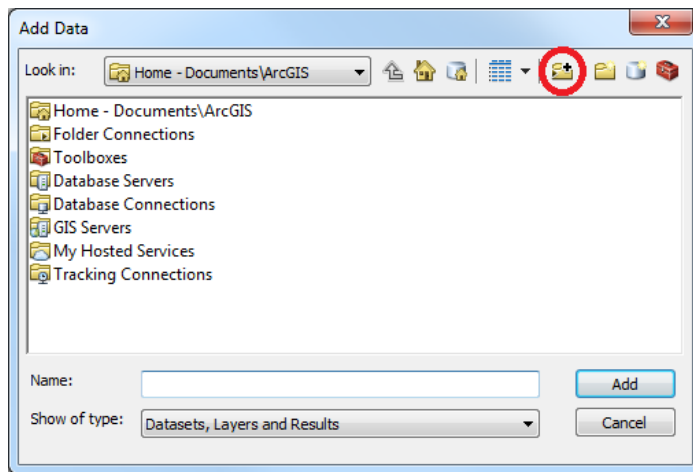
The Home folder contains all of the look-up tables, datafiles, models, and documentation required for AGWA to run. If this is set improperly or you are missing any files, you will be presented with a warning that lists the missing folders or files that AGWA requires.

The Temp folder is where some temporary files created during various steps in AGWA will be placed. You may want to routinely delete files and folders in the Temp folder if you need to free up space or are interested in identifying the temporary files associated with your next AGWA use.

The Default Workspace folder is where delineation geodatabases will be stored by default. This can be a helpful timesaver during the navigation process if you have a deeply nested folder structure where you store AGWA outputs.

## GIS Data

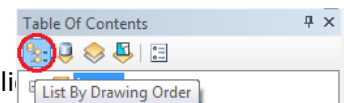
Before adding data to the map, connections to drives and folders where your data are stored must be established if they have not been already. To establish folder connections if they don't already exist, click on the **Add Data** button  below the menu bar at the top of the screen. In the Add Data form that opens, click the **Connect To Folder** button and select **OS (C:)**.



Once the folder connection is established, navigate to the [C:\AGWA\gisdata\tutorial\\_MountainFire\](#) folder and add the following datasets and layers:

- [..\dem\\_mtnfire](#)
- [..\fire\\_perim.shp](#)
- [..\Mountain\\_Final\\_SBS.shp](#)
- [..\nlcd\\_mtnfire](#)
- [..\statsgo\\_mtnfire.shp](#)
- [..\VARs.shp](#)

You will also need to add some other data to the project. To do this, again click the **Add** button. Navigate to the [C:\AGWA\datafiles\](#) folder and add the following files:



- [..\lc\\_luts\mrlc2001\\_lut\\_fire.dbf](#) – MRLC look-up table for pre-fire and post-fire NLCD land cover
- [..\lc\\_luts\mrlc2001\\_severity.dbf](#) – MRLC burn severity change table for NLCD land cover

Take a look at the data you have available to you to familiarize yourself with the area. Layers can be reordered, turned on/off, and their legends collapsed to suit your preferences and clean up the display. If the layers cannot be reordered by clicking and dragging, the **List By Drawing Order** button may need to be selected at the top of the **Table Of Contents**. Zoom back into the Mountain Fire region by right-clicking on the **dem\_mtnfire** grid in the list of layers and selecting **Zoom To Layer**.

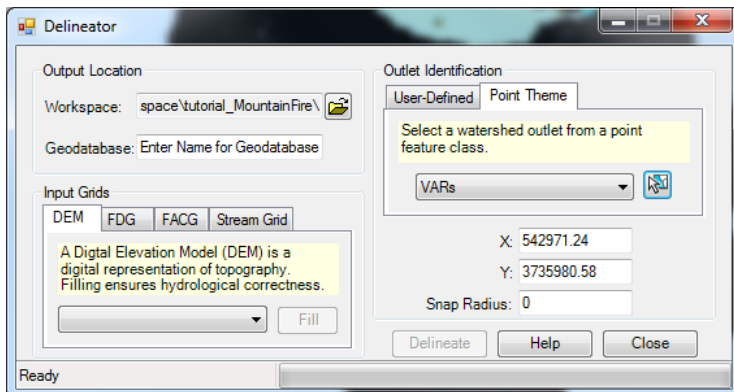
Save the map document and continue.


## Part 1: Modeling Runoff in Study Area Using Existing Pre-Fire Land Cover

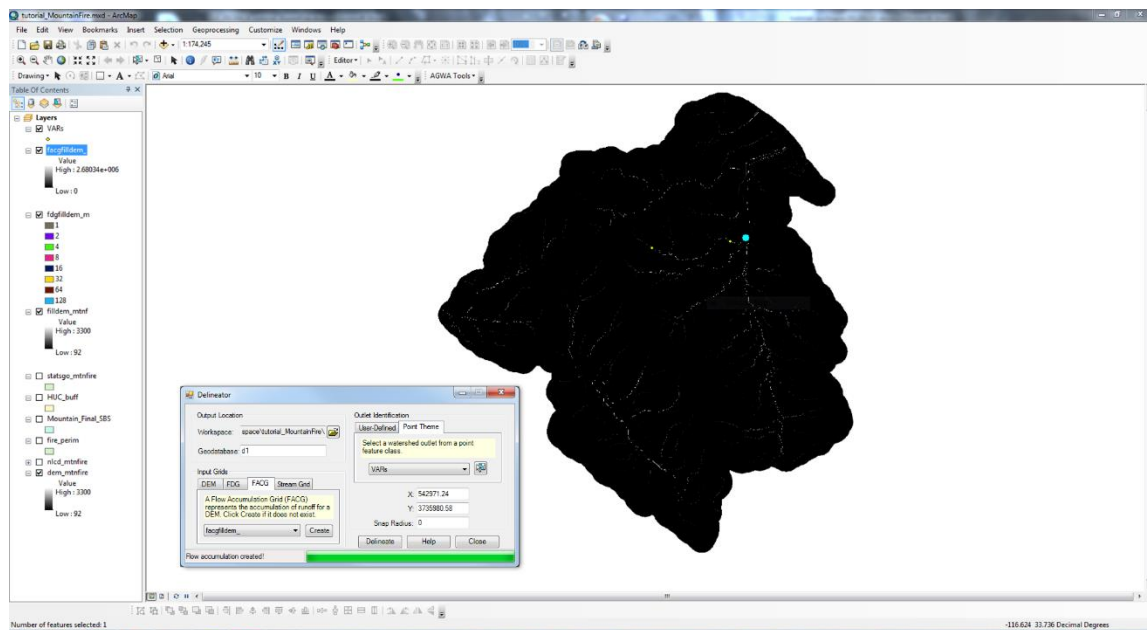
### Step 1: Delineating the watershed

Delineating creates a feature class that represents the entire area draining to a user-specified outlet. In order to delineate a watershed, AGWA first utilizes the Fill, Flow Direction, and Flow Accumulation tools from ArcToolbox.

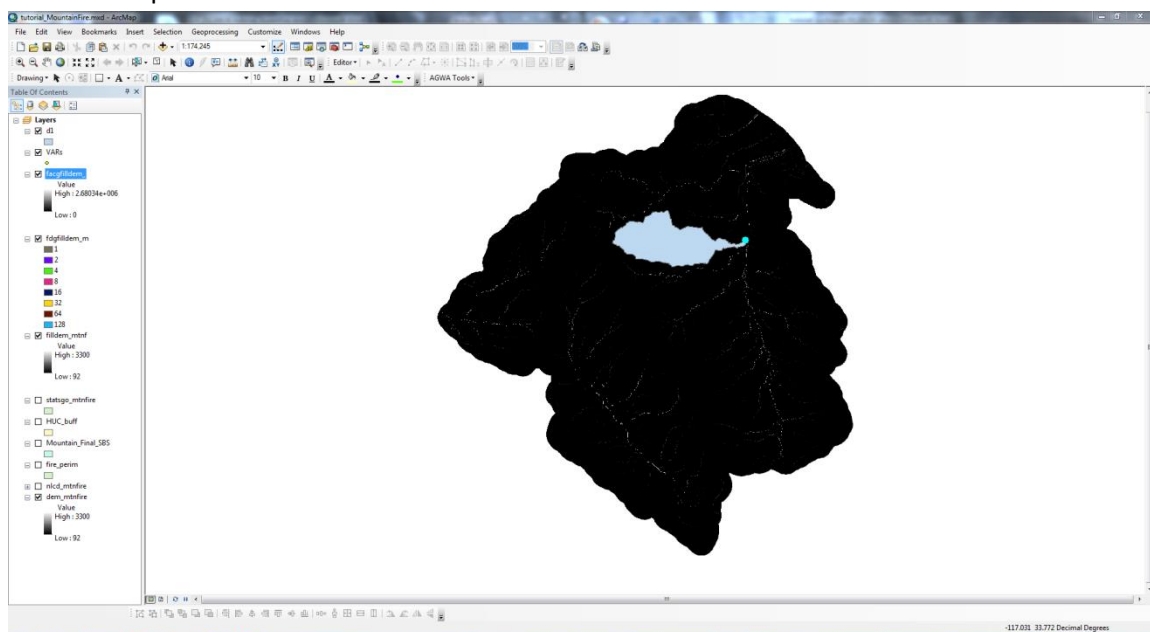
1. Perform the watershed delineation by selecting **AGWA Tools > Delineation Options > Delineate Watershed**.



- 1.1. **Output Location** box:
  - 1.1.1. **Workspace** textbox: navigate to and select/create **C:\AGWA\workspace\tutorial\_MountainFire**
  - 1.1.2. **Geodatabase** textbox: **d1**
- 1.2. **Input Grids** box:
  - 1.2.1. **DEM** tab: **dem\_mtnfire**
  - 1.2.2. Press the **Fill** button. This fills the DEM, and creates the **filldem\_mtnf** raster.
  - 1.2.3. **FDG** tab: Press the **Create** button. This creates the flow direction raster **fdgfilldem\_m**.
  - 1.2.4. **FACG** tab: Press the **Create** button. This creates the flow accumulation raster **facgfilldem\_**.
- 1.3. **Outlet Identification** box:
  - 1.3.1. **Point Theme** tab:
  - 1.3.2. **Outlets theme**: **VARs**
  - 1.3.3. Click the **Select Features** button  and draw a rectangle around the **Road Culvert** point (the point furthest to the right). The road culvert was chosen as the outlet because it is the furthest downstream of all the VARs in this watershed.



- 1.4. Click ***Delineate***.
- 1.5. Save the map document and continue.



## Step 2: Discretizing or subdividing the watershed

Discretizing breaks up the delineated watershed into model specific elements and creates a stream feature class that drains the elements.

2. Perform the watershed discretization by selecting ***AGWA Tools > Discretization Options > Discretize Watershed***.

**DESCRIPTION** In the Discretizer form, several parameters are defined including the model to use,



the complexity of the discretization, the name of the discretization, and whether additional pour points will be used to further control the subdivision of the watershed.

2.1. **Input** box:

2.1.1. **Delineation:** **d1\d1**

2.2. **Model Options** box:

2.2.1. **Model:** **KINEROS**

2.3. **Stream Definition** box:

2.3.1. **Method:** **CSA (Acres)**

2.3.2. **% Total Watershed:** do nothing (it should read **2.5**)


2.3.3. **Threshold:** do nothing (it should read **140.81**)

2.4. Expand the **Internal Pour Points** box:

2.4.1. Select the **Point Theme** tab page

2.4.2. **Point Theme:** **VARs**

2.4.3. **ID Field:** **Id**

2.4.4. Click the **Select Feature** button  and draw a rectangle around the **Stream Gage and Forest Service Boundary** points (the left-most two points, see Figure 1).

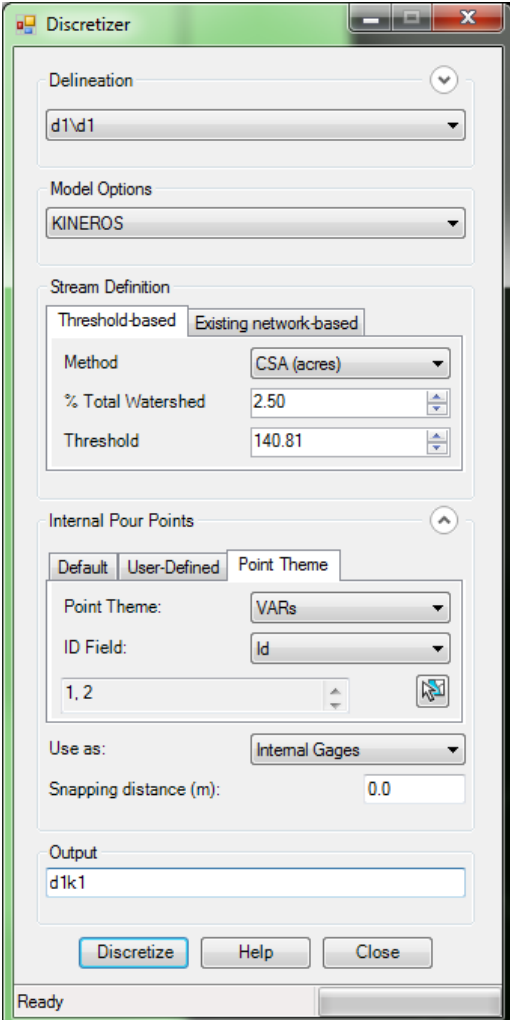
**DESCRIPTION** Pour points can be used to force the subdivision of watershed elements at user-supplied points, either by clicking on the map or selecting points from a point theme. Since KINEROS2 is run for each individual element in a watershed, model outputs can be viewed at each element or pour point. This is useful for upstream VARs, so that BAER resource specialists can see model outputs at each VAR in the watershed, not just the outlet.

2.5. **Output** box:

2.5.1. **Name:** enter **d1k1**

2.6. Click **Discretize**.

2.7. Zoom to the newly created **planes\_d1k1** layer.  
Save the map document and continue.

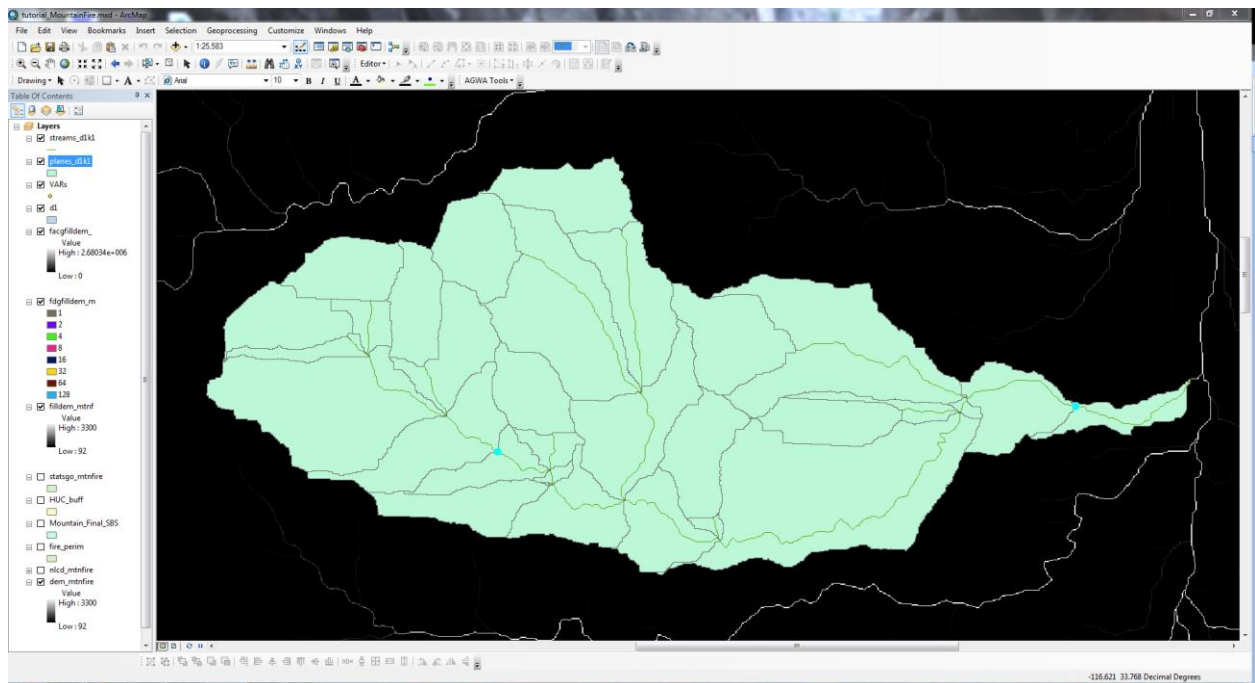


The screenshot shows the 'Discretizer' dialog box with the following settings:

- Delineation:** d1\d1
- Model Options:** KINEROS
- Stream Definition:**
  - Threshold-based / Existing network-based (selected)
  - Method: CSA (acres)
  - % Total Watershed: 2.50
  - Threshold: 140.81
- Internal Pour Points:**
  - Default / User-Defined / Point Theme (selected)
  - Point Theme: VARs
  - ID Field: Id
  - 1, 2 (points selected)
  - Use as: Internal Gages
  - Snapping distance (m): 0.0
- Output:** d1k1

Buttons: Discretize, Help, Close

Discretizing breaks up the delineation/watershed into model specific elements and creates a stream feature class that drains the elements. The CSA, or Contributing/Channel Source Area, is a threshold value which defines first order channel initiation, or the upland area required for channelized flow to begin. Smaller CSA values result in a more complex watershed, and larger CSA values result in a less complex watershed. The default CSA in AGWA is set to 2.5% of the total watershed area. The discretization process created a subwatersheds layer with the name planes\_d1k1 and a streams map named streams\_d1k1. In AGWA, discretizations are referred to with their geodatabase name as a prefix followed by the discretization name given in the Discretizer form, e.g. d1\d1k1.

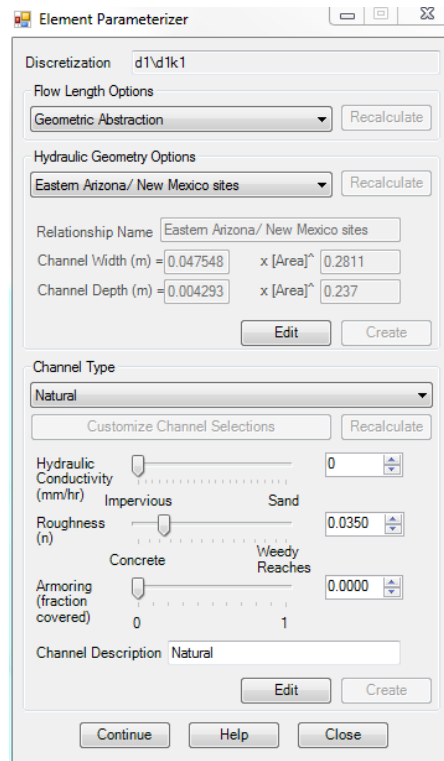
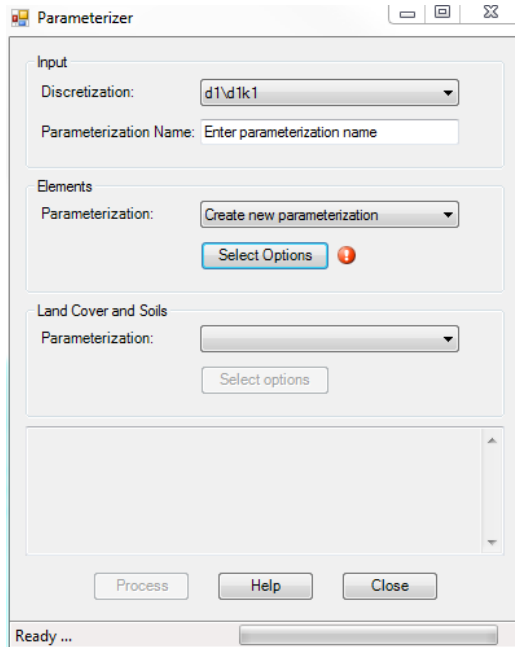


### Step 3: Parameterizing the watershed elements for KINEROS2

Parameterizing defines model input parameters based on topographic, land cover, and soils properties. Model input parameters represent the physical properties of the watershed and are used to write the model input files.

3. Perform the element, land cover, and soils parameterization of the watershed by selecting **AGWA Tools > Parameterization Options > Parameterize**.
  - 3.1. **Input** box:
    - 3.1.1. **Discretization:** **d1\d1k1**
    - 3.1.2. **Parameterization Name:** **pre**
  - 3.2. **Elements** box:
    - 3.2.1. **Parameterization:** **Create new parameterization**
    - 3.2.2. Click **Select Options**. The **Element Parameterizer** form opens.





3.3. In the **Element Parameterizer** form:

3.3.1. **Flow Length Options:** **Geometric Abstraction**

3.3.2. **Hydraulic Geometry Options** box:

3.3.2.1. Select the **Eastern Arizona/New Mexico sites** item.

Do not click the **Recalculate** button.

Do not click the **Edit** button.

Hydraulic geometry relationships define bankfull channel width and depth based on watershed size. Bankfull relationships are useful in that they define channel topography with minimal input and effort by the user; however, there are some drawbacks. The relationships are designed to be applied to very specific physiographic regions and outside of these regions the performance of the relationships in accurately depicting the channel geometries severely declines. In a BAER rapid assessment situation, it may be best to take field measurements to double-check the accuracy of the predefined hydraulic geometries. Field measurements by the Mountain Fire BEAR team found the Eastern Arizona/New Mexico relationships to fit reasonably well, so it is used here.

3.3.3. **Channel Type** box:

3.3.3.1. Select the **Natural** item.

3.3.3.2. Click the **Edit** button.

3.3.3.3. Change the **Hydraulic Conductivity** to **0**.

3.3.3.4. Do not change the **Roughness** and **Armoring** values.

There are three channel types available by default: Default, Natural, and Developed. The Default channel type is equivalent to the Natural channel type. The Natural channel type reflects a sandy channel bottom with high infiltration and a winding but clean channel with roughness set to 0.035 Manning's n. The Developed channel type reflects a concrete channel with zero infiltrability, very low roughness set to 0.010 Manning's n, and fraction of channel armored against erosion equal to 1. Since Andreas Creek is a natural but perennial stream, the Natural default hydraulic conductivity of 210 is not realistic. Instead, the value was reduced using the provided trackbar or numerical textbox.

3.3.4. Click **Continue**. You will be returned to the **Parameterizer** form to create the Land Cover and Soils parameterization.

3.4. Back in the **Land Cover and Soils** box of the **Parameterizer** form

3.4.1. **Parameterization: Create new parameterization**

3.4.2. Click **Select Options**. The **Land Cover and Soils** form opens.

3.5. In the **Land Cover and Soils** form:

3.5.1. **Land Cover** tab:

3.5.1.1. **Land cover grid: nlcd\_mtnfire**

3.5.1.2. **Look-up table:** [mrlc2001\\_lut\\_fire](#)

**NOTE** If the *mrlc2001\_lut\_fire* table is not present in the combobox, you may have forgotten to add the table to the map earlier. If this is the case, click on the **Add Data** button and browse to the [C:\AGWA\datafiles\lc\\_luts\](#) folder and select [mrlc2001\\_lut\\_fire](#), then select the [mrlc2001\\_lut\\_fire](#) table from the combobox.

3.5.2. **Soils** tab:

3.5.2.1. **Soils** layer: [statsgo\\_mtnfire](#)

3.5.2.2. **Soils database:** navigate to and select

[C:\AGWA\gisdata\tutorial\\_MountainFire\wss\\_gsmsoil\\_CA\\_\[2006-07-06\]\soildb\\_US\\_2003.mdb](#)

- 3.6. Click **Continue**. You will be returned to the **Parameterizer** form where the **Process** button will now be enabled.

The screenshot shows the 'Parameterizer' window with the following sections:

- Input:** Discretization: d1\d1k1; Parameterization Name: pre
- Elements:** Parameterization: Create new parameterization; Select Options (with a green checkmark)
- Land Cover and Soils:** Parameterization: Create new parameterization; Select options (with a green checkmark)
- Log:** - Land cover & soils parameterization options recorded successfully  
- Element parameterization options recorded successfully
- Buttons:** Process, Help, Close
- Status Bar:** Ready ...

3.7. In the **Parameterizer** form, click **Process**.

In the last step, parameterization look-up tables for the overland flow elements and stream elements have been created to store the model input parameters representing the physical properties of the watershed.

## Step 4: Preparing rainfall files

4. Write the KINEROS2 precipitation file for the watershed by selecting **AGWA Tools > Precipitation Options > Write KINEROS Precipitation**.

KINEROS Precipitation

Select discretization: d1\d1k1

Storm Depth

NOAA Database User-Defined Depth User-Defined Hyetograph

Time steps: 7

Depth (mm): 32.02

Duration (hrs): 1

Storm Location

☒ Apply to entire watershed

☐ Apply to individual elements

☐ Apply to area defined below

Storm Center

☐ Discretization centroid X

☒ User defined Y

Radius (m)

Storm/hyetograph shape: SCS Type II

Initial soil moisture: 0.14 0.20 0.93

Precipitation filename: 10y1h

Write Help Close

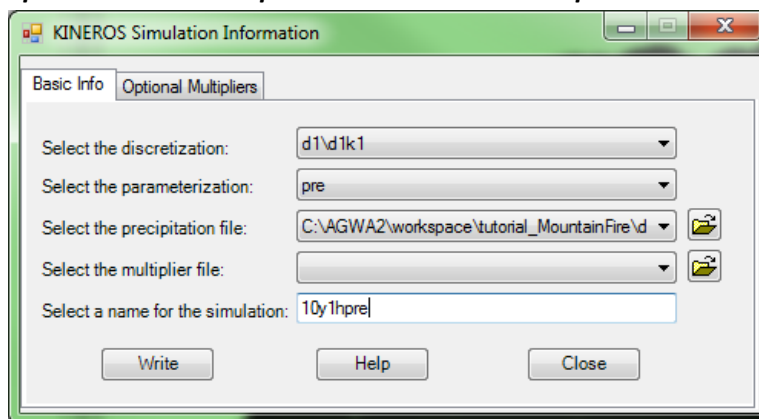
- 4.1. **KINEROS Precipitation** form
  - 4.1.1. **Select discretization:** d1\d1k1
  - 4.1.2. **Storm Depth** box:
    - 4.1.2.1. **User-Defined Depth** tab:
      - 4.1.2.1.1. **Time Steps:** 7
      - 4.1.2.1.2. **Depth (mm):** 32.02
      - 4.1.2.1.3. **Duration (hrs):** 1
  - 4.1.3. **Storm Location** box:
    - 4.1.3.1. Select **Apply to entire watershed** radio button.
  - 4.1.4. **Storm/hyetograph shape:** SCS Type II
  - 4.1.5. **Initial Soil Moisture:** 0.20
  - 4.1.6. **Precipitation Filename:** 10y1h
  - 4.1.7. Click **Write**.

**DESCRIPTION** AGWA offers several methods of user-defined rainfall input. They include using a National Oceanic and Atmospheric Administration (NOAA) Precipitation-Frequency grid, a user-defined storm, a user-defined hyetograph, or a pre-defined storm taken from a database. In this exercise, the storm was chosen by consulting a 10-year, 1-hour NOAA Precipitation-Frequency grid. The maximum depth shown within the fire perimeter was used, which was 32.02 mm (1.26 in). The maximum depth was chosen as a conservative value. The 10-year, 1-hour design storm was chosen by consulting local experts and BAER hydrologists to determine a representative storm in the burned area.

## Step 5: Writing KINEROS2 input files

Writing the model input files creates a simulation directory and writes all required input files for the model. When writing the input files, AGWA loops through features of the selected discretization and reads the model parameters from the parameterization look-up tables to write into the input files for the model.

5. Write the KINEROS2 simulation input files for the watershed by selecting **AGWA Tools > Simulation Options > KINEROS Options > Write KINEROS Input Files**.



### 5.1. Basic Info tab:

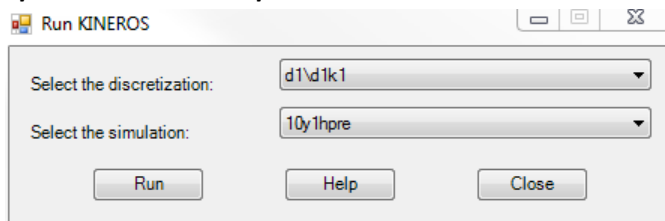
- 5.1.1. **Select the discretization:** **d1\d1k1**
- 5.1.2. **Select the Parameterization:** **pre**
- 5.1.3. **Select the precipitation file:** **10y1h.pre**
- 5.1.4. **Select the multiplier file:** leave blank
- 5.1.5. **Select a name for the simulation:** **10y1hpre**

### 5.2. Click **Write**.

## Step 6: Executing the KINEROS2 model

Executing the KINEROS model opens a command window where the model is executed. By default, the command window stays open so that success or failure of the simulation can be verified.

6. Run the KINEROS2 model for the Andreas Canyon watershed by selecting **AGWA Tools > Simulation Options > KINEROS Options > Execute KINEROS Model.**



- 6.1. **Select the discretization: d1\d1k1**
- 6.2. **Select the simulation: 10y1hpre**
- 6.3. Click **Run**. The command window will stay open so that successful completion can be verified. Press any key to continue. Close the **Run KINEROS** window.

```

C:\Windows\system32\cmd.exe

C:\AGWA2\mxds>pushd C:\AGWA2\workspace\tutorial_MountainFire\d1\d1k1\simulations\10y1hpre\
C:\AGWA2\workspace\tutorial_MountainFire\d1\d1k1\simulations\10y1hpre>k2 -b

Processing CHANNEL      84
Event Volume Summary:
      Rainfall      32.02001 mm      729867.2 cu m
Plane infiltration  25.28431      576333.1
Interception       0.62606      14270.4
Storage            0.00753      171.7
Outflow            5.88278      134092.7

Error <Volume in - Volume out - Storage> < 1 percent
Time step was adjusted to meet Courant condition
Time step is too large: element hydrographs are not well-represented!
Total watershed area = 2279.410 ha
Sediment yield = 78.35387 tons/ha
Sediment yield by particle class:
Particle size <mm>    0.250      0.033      0.004
Yield <tons/ha>      72.68140      5.18393      0.48854

C:\AGWA2\workspace\tutorial_MountainFire\d1\d1k1\simulations\10y1hpre>popd
C:\AGWA2\mxds>pause
Press any key to continue . . .

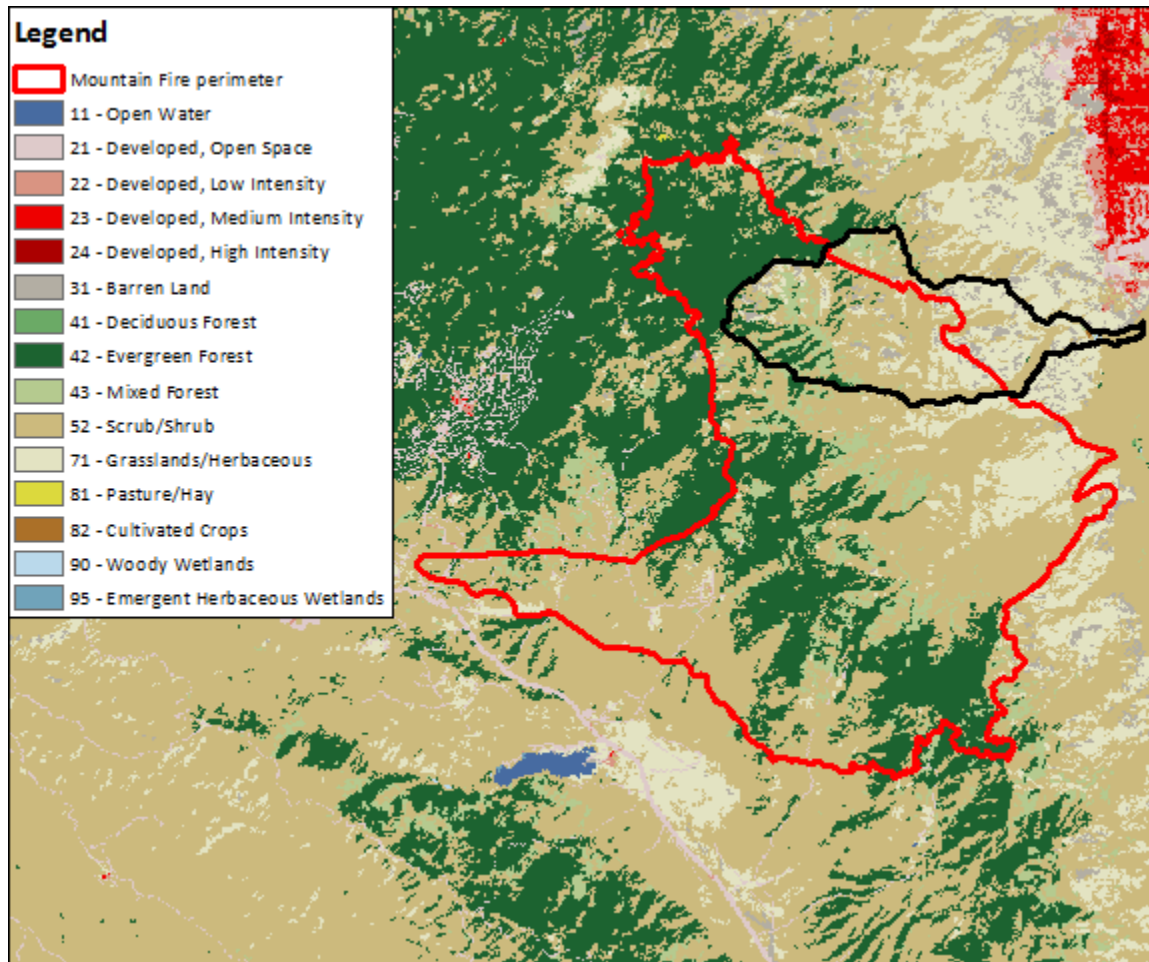
```

At this point, pre-fire conditions have been simulated; post-fire land cover will be created in part 2 and then simulated in part 3 so that the analysis can be performed in part 4.



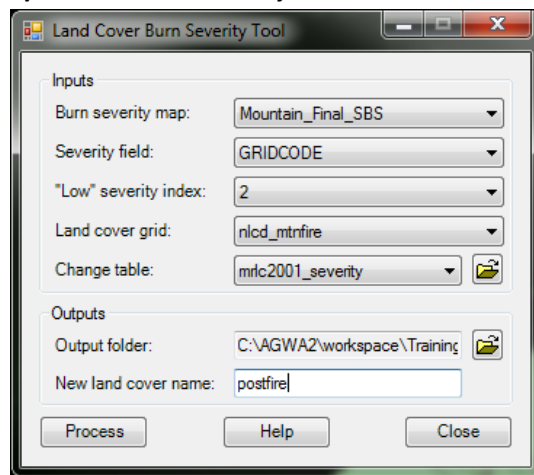
## Part 2: Create Post-Fire Land Cover


In Part 2, the pre-fire land cover will be used along with a burn severity map representing low, moderate, and high burn severities to create a post-fire land cover product.

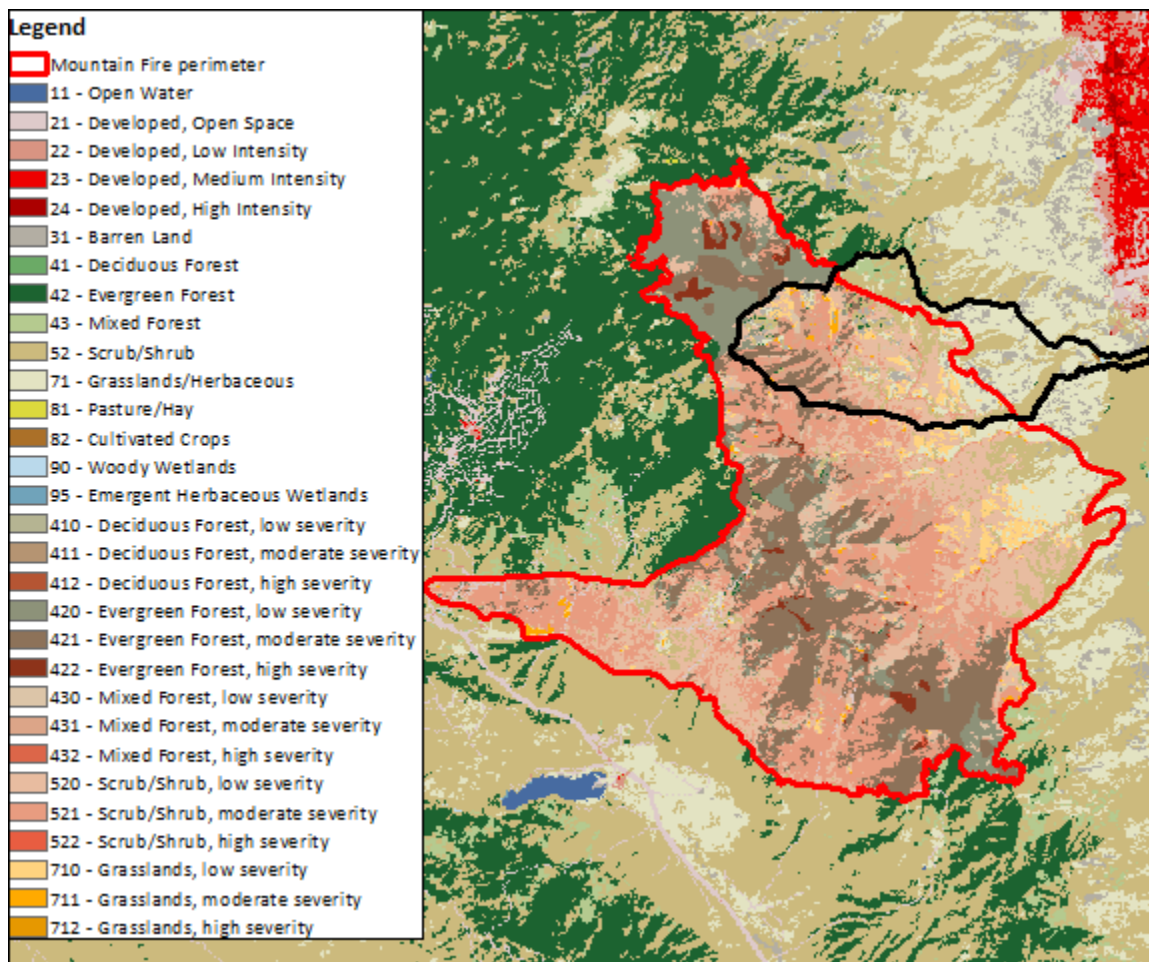
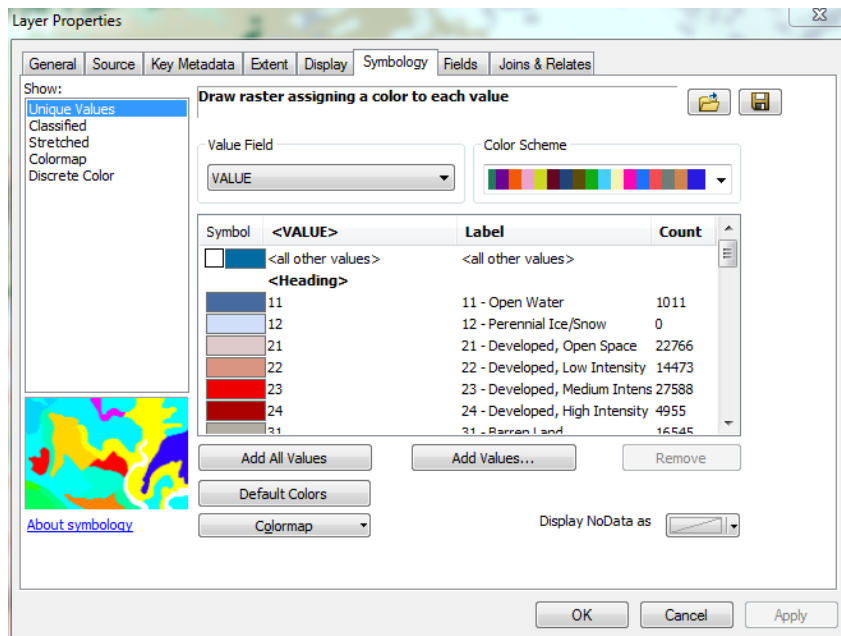


In a BAER situation, a Burned Area Reflectance Classification (BARC) map is provided and then verified and modified by BAER experts. The final burn severity map can be imported directly into AGWA to modify the pre-fire (NLCD 2006 in this case) land cover. Based on the pre-fire land cover class along with the burn severity, AGWA changes several input parameters into KINEROS2. These parameter changes are applied to the hillslope roughness coefficient, hydraulic conductivity, and percent cover.

7. Perform the land cover modification for the post-fire land cover by selecting **AGWA Tools > Other Options > Burn Severity Tool**.



- 7.1. **Inputs** box:
  - 7.1.1. **Burn severity map:** Mountain\_Final\_SBS
  - 7.1.2. **Severity field:** GRIDCODE
  - 7.1.3. **"Low" severity index:** 2
  - 7.1.4. **Land cover grid:** nlcd\_mtnfire
  - 7.1.5. **Change table:** mrlc2001\_severity
- 7.2. **Outputs** box:
  - 7.2.1. **Output folder:** navigate to and select C:\AGWA\workspace\tutorial\_MountainFire\
  - 7.2.2. **New land cover name:** postfire
- 7.3. Click **Process**.
8. At this point, the **postfire** raster representing the post-fire land cover has been created. To better visualize the different land cover types and associate the pixels with their classification, load a legend into the **nlcd\_mtnfire** and **postfire** datasets.
  - 8.1. To do this, right click the layer name of the **nlcd\_mtnfire** dataset in the **Table of Contents** and select **Properties** from the context menu that appears.
  - 8.2. Select the **Symbology** tab from the form that opens. In the **Show** box on the left side of the form, select **Unique Values** and click the **Browse** button  on the right. Click the file browser button, navigate to and select C:\AGWA\datafiles\renderers\nlcd2001.lyr and click on **Add**, then click **OK** to apply the symbology and exit the **Import Symbology** form.
  - 8.3. Click on **Apply** in the **Layer Properties** form and then on **OK** to exit this form.
  - 8.4. The **nlcd\_mtnfire** and **postfire** datasets have the same legend and classification, so repeat the same procedure for the **postfire** dataset.



9. To check that the **postfire** dataset matches the original burn severity map (**Mountain\_Final\_SBS**), turn all the layers in the Table of Contents off except for **nlcd\_mtnfire**, **Mountain\_Final\_SBS** and **postfire** by unchecking the checkbox next to the layer names. Toggle these three layers on and off and drag them above or below each other to see how the pre-fire land cover has been modified to match the burn severity map. After you're satisfied, you can rearrange the order of the layers and turn them on/off to your liking.

## Part 3: Modeling Runoff in Study Area Using Post-Fire Land Cover

In Part 3, a new parameterization will be created using the post-fire land cover dataset created in Part 2, and then it will be used to write a different set of model input files to execute the model.

### Step 1: Parameterizing the watershed elements with post-fire land cover

AGWA can store multiple parameterizations in the parameterization look-up tables. Running the parameterization with a different set of options (element, soils, or land cover) will append data to the existing look-up tables instead of overwriting them, so the parameterization can be accessed again at a later time. In a new parameterization, if only one part is different from an existing parameterization, AGWA can copy the parameters from an existing parameterization to save time.

10. Rerun the parameterization of the watershed with the postfire land cover by selecting **AGWA Tools > Parameterization Options > Parameterize**.

- 10.1. **Input** box:

- 10.1.1. **Discretization**: **d1\d1k1**

- 10.1.2. **Parameterization Name**: **post**

- 10.2. **Elements** box:

- 10.2.1. **Parameterization**: **pre**

Land cover change is the emphasis of this exercise and no other changes will be made; because no other options are changing, the element parameterization parameters can be copied from an existing parameterization.

- 10.3. **Land Cover and Soils** box:

- 10.3.1. **Parameterization**: **Create new parameterization**

- 10.3.2. Click **Select Options**. The **Land Cover and Soils** form opens.

- 10.4. In the **Land Cover and Soils** form:

- 10.4.1. **Land Cover** tab:

- 10.4.1.1. **Land cover grid**: **postfire**

- 10.4.1.2. **Look-up table**: **mrlc2001\_lut\_fire**

- 10.4.2. **Soils** tab:

- 10.4.2.1. **Soils** layer: **statsgo\_mtnfire**

- 10.4.3. **Soils database**: navigate to and select:

**C:\AGWA\gisdata\tutorial\_MountainFire\wss\_gsmsoil\_CA\_[2006-07-06]\soildb\_US\_2003.mdb**

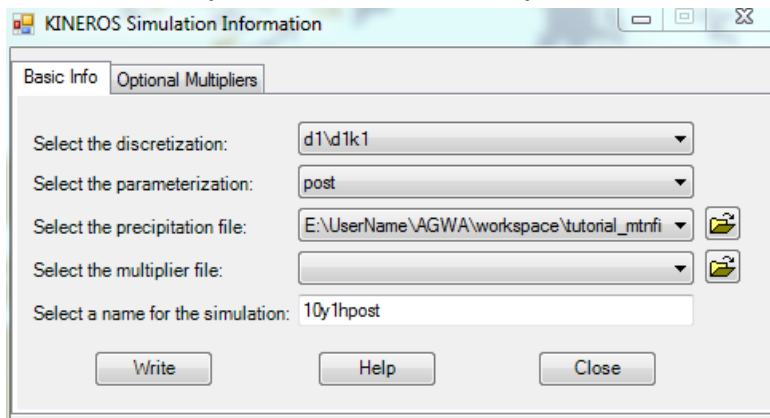
10.5. Click **Continue**. You will be returned to the **Parameterizer** form where the **Process** button will now be enabled.

10.6. In the **Parameterizer** form, click **Process**.

## Step 2: Writing KINEROS2 input files

The same precipitation file used in the pre-fire simulation will be used in the post-fire simulation, so the writing of the KINEROS2 precipitation file performed earlier will be skipped now.

11. Write the KINEROS2 simulation input files for the watershed by selecting **AGWA Tools > Simulation Options > KINEROS Options > Write KINEROS Input Files**.



11.1. **Basic Info** tab:

11.1.1. **Select the discretization:** **d1\d1k1**

11.1.2. **Select the parameterization:** **post**

11.1.3. **Select the precipitation file:** **10y1h.pre**

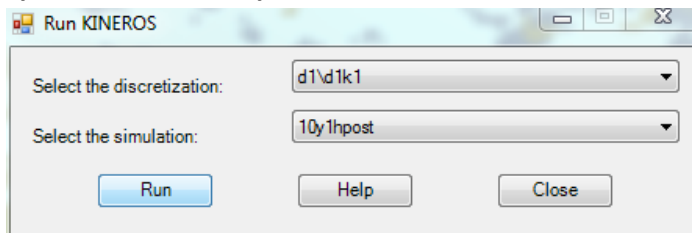
11.1.4. **Select the multiplier file:** leave blank

11.1.5. **Select a name for the simulation:** **10y1hpost**

11.2. Click **Write**.

## Step 3: Executing the KINEROS2 model

12. Run the KINEROS2 model for the Andreas Canyon watershed by selecting **AGWA Tools > Simulation Options > KINEROS Options > Execute KINEROS Model**.



12.1. **Select the discretization:** **d1\d1k1**

12.2. **Select the simulation:** **10y1hpost**

- 12.3. Click **Run**. The command window will stay open so that successful completion can be verified. Press any key to continue. Close the **Run KINEROS** window.

```
C:\Windows\system32\cmd.exe

C:\AGWA2\mxds>pushd C:\AGWA2\workspace\tutorial_MountainFire\d1\d1k1\simulations\10y1hpost\

C:\AGWA2\workspace\tutorial_MountainFire\d1\d1k1\simulations\10y1hpost>k2 -b

Processing CHANNEL      84

Event Volume Summary:

      Rainfall      32.02001 mm      729867.2 cu m
Plane infiltration  24.43840      557051.4
Interception       0.44025      10035.1
Storage            0.00777       177.1
Outflow            6.95043      158428.8

Error <Volume in - Volume out - Storage> < 1 percent
Time step was adjusted to meet Courant condition
Time step is too large: element hydrographs are not well-represented!
Total watershed area = 2279.410 ha
Sediment yield = 106.9824 tons/ha
Sediment yield by particle class:
Particle size <mm>    0.250      0.033      0.004
Yield <tons/ha>      98.3753      7.8893      0.7177

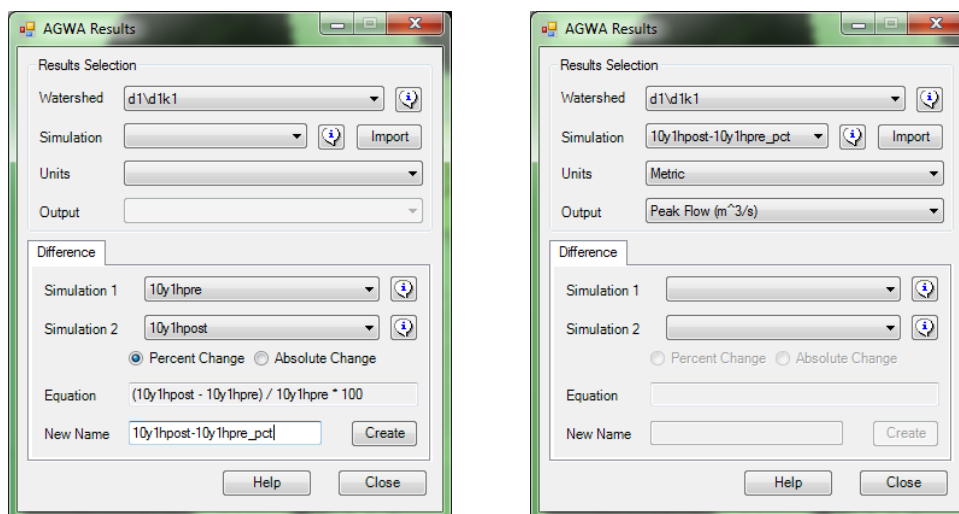
C:\AGWA2\workspace\tutorial_MountainFire\d1\d1k1\simulations\10y1hpost>popd
C:\AGWA2\mxds>pause
Press any key to continue . . . _
```

At this point, pre-fire and post-fire conditions have been simulated; in part 4, the pre-fire and post-fire simulations will be directly compared.

## Part 4: Comparing Results from Pre-Fire and Post-Fire Scenarios

In Part 4, the results from the pre-fire and post-fire simulations will be imported into AGWA. These results will then be differenced to visually see how the fire impacts the hydrology of the watershed.

13. Import the results from the two simulations by selecting **AGWA Tools > View Results > KINEROS Results > View KINEROS Results**.





13.1. **Results Selection** box:

13.1.1. **Watershed:** **d1\d1k1**

13.1.2. **Simulation:** click **Import**

13.1.2.1. **Yes** to importing **10y1hpost**

13.1.2.2. **Yes** to importing **10y1hpre**

14. Difference the pre-fire and post-fire simulation results.

14.1. **Difference** tab:

14.1.1. **Simulation1:** **10y1hpre**

14.1.2. **Simulation2:** **10y1hpost**

14.1.3. Select **Percent Change** radiobutton

14.1.4. **New Name:** enter **10y1hpost-10y1hpre\_pct**

14.1.5. Click **Create**.

15. View the differenced results.

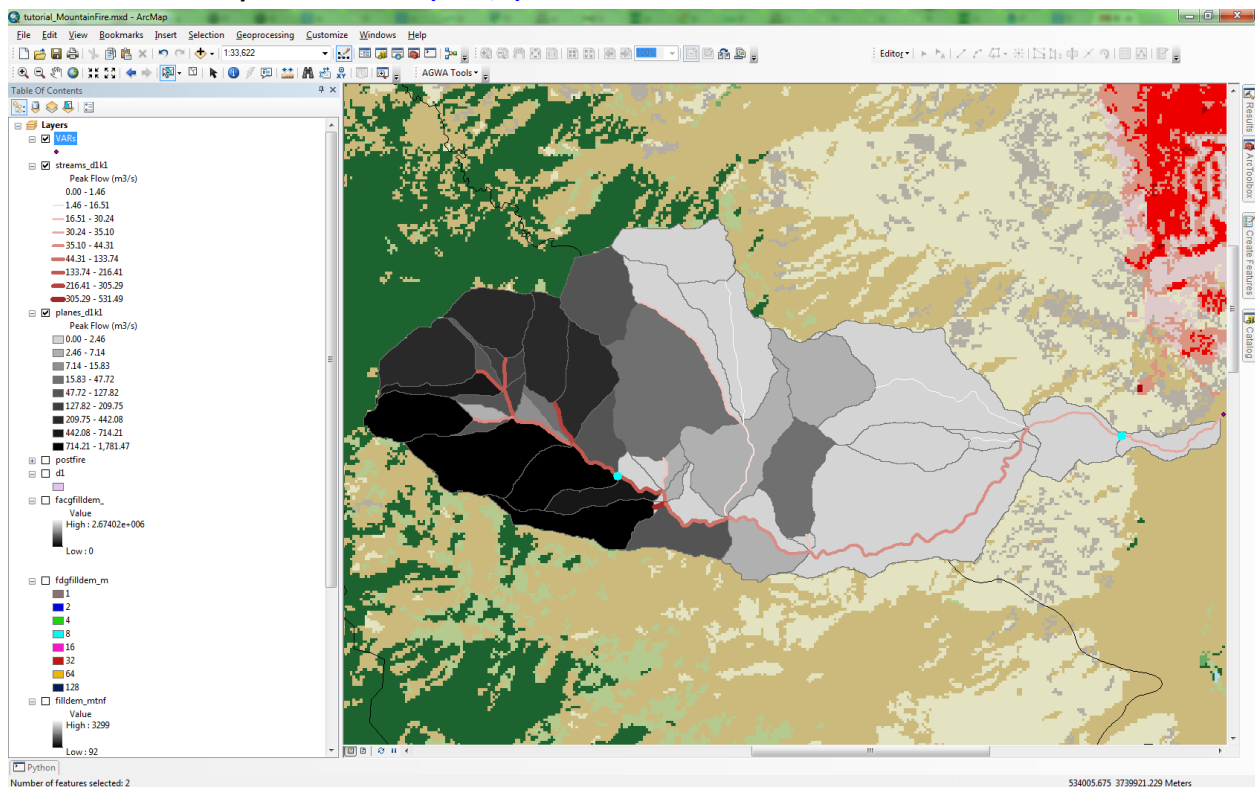
15.1. **Results Selection** box:

15.1.1. **Watershed:** **d1\d1k1**

15.1.2. **Simulation:** **10y1hpost-10y1hpre\_pct**

15.1.3. **Units:** **Metric** (Note: since we are looking at percent change, the units are arbitrary)

15.1.4. **Output:** **Peak Flow (m<sup>3</sup>/s)**



This map shows the percent change in peak flow between the pre- and post-fire simulations for the 10-year, 1-hour design storm. This can be helpful to show which hillslopes and which stream reaches are at risk to the highest amount of change in watershed response due to the fire.

16. View and compare hydrographs for two simulations by selecting **AGWA Tools > View Results > KINEROS Results > View Hydrograph**.

16.1. **Generate Hydrograph Files** box:


16.1.1. **Watershed:** **d1\d1k1**

16.1.2. **Simulation:** **10y1hpre**

16.1.3. Check the **Compare with following simulation** checkbox.

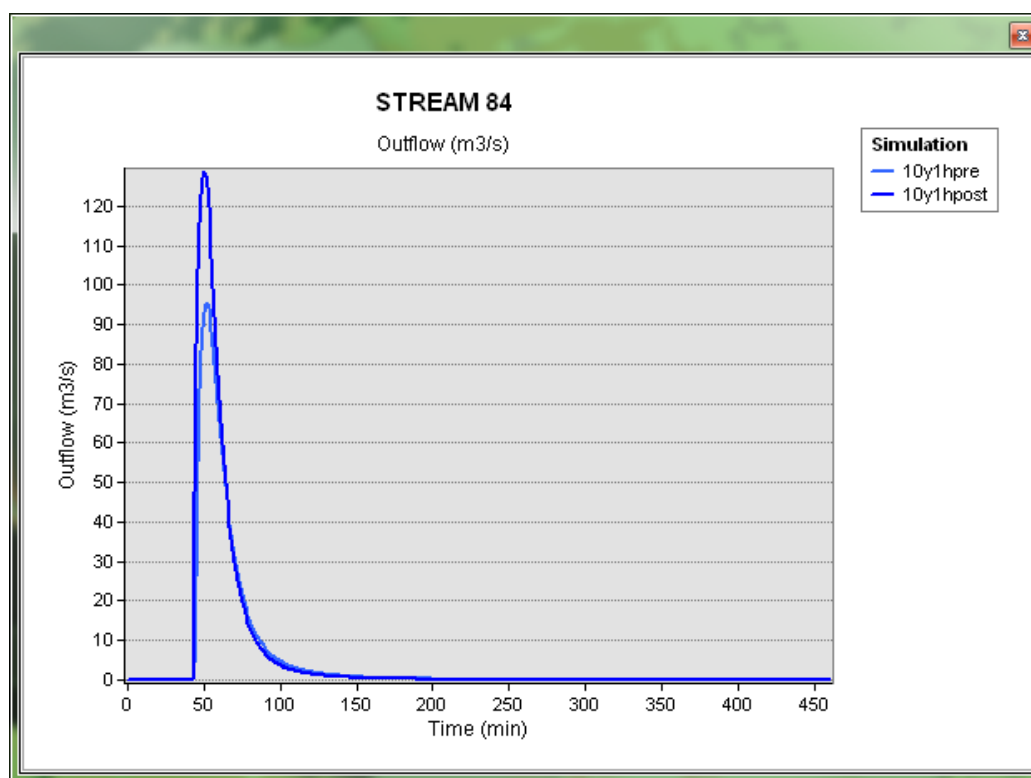
16.1.4. **Simulation 2:** **10y1hpost**


16.2. View Hydrograph box:

16.2.1. Click the **Select Feature** button  and draw a rectangle around the stream reach furthest downstream, directly upstream from the road culvert point.

16.2.2. Select **Metric**.

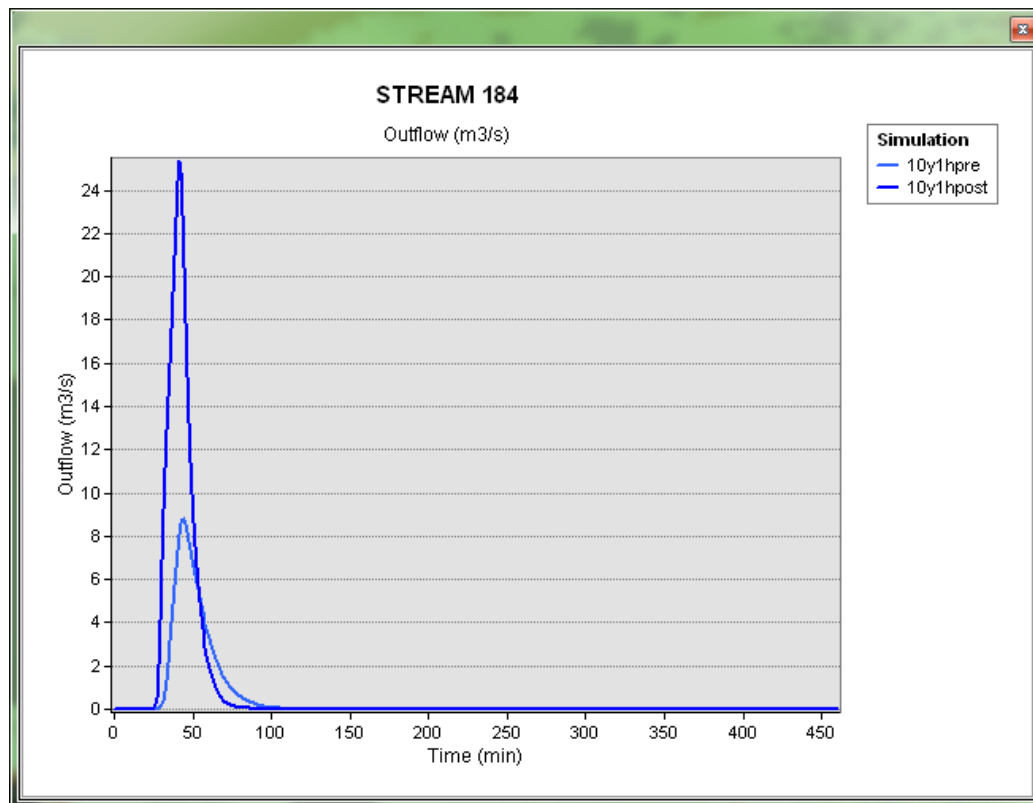
16.2.3. Select **Outflow (m3/s)**. A graph will now open showing the hydrographs for both the pre- and post-fire simulations at the outlet of the watershed.



16.2.4. Click the **Select Feature** button  and draw a rectangle around the stream reach directly upstream of the Forest Service Boundary point (the left most point, see Figure 1). You may have to make the **VARs** layer visible again, and place it above **streams\_d1k1** and **planes\_d1k1** to locate this stream reach.

16.2.5. Select **Metric**.

16.2.6. Select **Outflow (m3/s)**. A graph will now open showing the hydrographs for both the pre- and post-fire simulations at the Forest Service Boundary location.



Notice that the peak flow is much lower at the Forest Service Boundary than at the outlet, but the percent change is higher. These results are due to the fact the Forest Service Boundary is further up in the watershed with less contributing area, but all of that contributing area has been burned. Downstream at the road culvert, the larger contributing area caused a higher peak flow for both the pre- and post-fire simulations, but since much of the watershed was unburned, the percent change is lower. These hydrographs are useful to compare how the watershed response will change after fire at specific VARs. However, in a BAER rapid assessment situation such as after the Mountain Fire, proper calibration was not performed. Therefore, trusting the absolute values shown by these hydrographs is not recommended. Instead, focusing on the relative (percent) change is a better strategy when dealing with uncalibrated watersheds.

## References

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- Goodrich, D.C., H.E. Canfield, I.S. Burns, D.J. Semmens, S.N. Miller, M. Hernandez, L.R. Levick, D.P. Guertin, and W.G. Kepner, 2005. Rapid post-fire hydrologic watershed assessment using the AGWA GIS-based hydrologic modeling tool. In: Proceedings, ASCE Watershed Management Conference, Williamsburg, VA, July 19-22, 2005.

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